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(71) Applicant: **Courtoy**
1500 Halle (BE)

(72) Inventors:
- **Van de Voorde, Koen**
  9450 Haaltert (BE)
- **Van Zegbroeck, Antonie**
  9451 Kerksken (BE)

(74) Representative:
Van Reet, Joseph et al
Gevers Patents S.A.,
Brussels Airport Business Park,
Holidaystraat 5
1831 Diegem (BE)

(54) Rotary tablet press

(57) A rotary tablet press comprising a rotating turret (5) provided with peripheral dies (10), a feeder system for introducing product for the tablets into the dies (10), a scraper (27) for scraping off excess of product introduced in the dies (10), a series of lower (14) and upper punches (13) which are slidably fixed to said turret (5) and arranged to compress the product introduced in said dies (10). The turret (5) comprises moreover a circumferential upstanding wall (22) around said dies (10) defining an enclosed space (24) which forms part of the feeder system and which is adapted to contain a supply of the product. The scraper (27) is arranged in said enclosed space (24) and said punches (13, 14) and said cams (15, 16) are arranged to eject the produced tablets from the bottom of said dies (10). In this way product losses can be avoided.

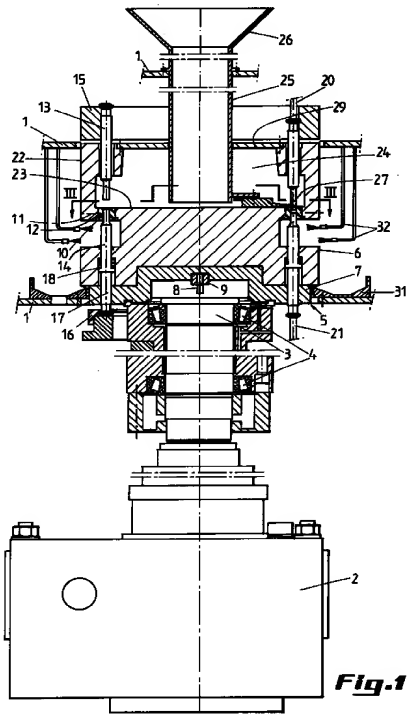

Fig.1

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Description

The present invention relates to a rotary tablet press comprising a rotating turret provided with peripheral dies, a feeder system for introducing product for the tablets into the dies, a scraper for scraping off excess of product introduced in the dies, a series of lower and upper punches which are slidably fixed to said turret and arranged to compress the product introduced in said dies according to a cyclic movement into tablets and a lower and upper cam cooperating respectively with said lower and upper punches to move these punches according to said cyclic movement upon rotation of the turret.

The compression module of the current classic rotary presses using gravity feed are composed of a turret featuring a number of positions with three vertical holes in each of these positions. These positions are equally distributed on the pitch diameter of the turret. The top hole is guiding an upper punch, in the central hole a die is located, the bottom hole is used to guide a lower punch. The rotation of the turret moves the punches through a sequence of cams and rollers to produce the tablets.

The cycle to produce one tablet (compression cycle) is one of the positions going sequentially through the following steps. The cycle starts at overfill where the upper punch is in its highest position and the lower punch in its lowest position allowing the feeder system to fill the cavity of the die with the product for the tablet, which may be either a powder or a granulate. In the next step the upper and lower punches are moved with force towards each other in order to press the material together and form the tablet, this step can happen in one or two steps. The last step is when the upper and lower punches move upwards to eject the tablet from the die and the press. The positions are moved through the different steps by the rotation of the turret.

The feeder system is an external feature used to bring a volume of powder in the die by gravity. This feeder system is located on the periphery of the turret. When the die passes under the feeder the die is filled with the volume of product determined by the position of the lower punch in the die. In the following stage the lower punch is moved up to an adjustable position allowing the correct volume of product to be kept in the die by scraping away the excess of granulate or powder.

The major disadvantage of such a system is the need for an accurate adjustment of the feeder with respect to the die table, this in order to minimise product loss. Scraping off the excess of product also causes product losses, even if most of the product can be reused, not all of the product can be reused. Moreover, the product is compressed by moving the punches towards each other. The relatively high speed at which the upper punch enters the die generates additional product losses. These product losses are not only important from an economical point of view but part of these product losses cause a contamination of the external sections of the press due to the centrifugal forces to which they are subjected and may thus be harmful for the operator.

In practice, attempts have already been made to eliminate the above described product losses by proposing rotary presses wherein the product is fed through radial borings, under the influence of high centrifugal forces, directly into the die cavities. However, up till now, such rotary presses have the important drawback that, due to the high centrifugal forces which have to be exerted onto the product, the produced tablets show a density gradient, or in other words a varying consistency.

An object of the present invention is therefore to obviate the hereinabove described drawbacks by providing a rotary tablet press of the gravity feed type showing less product losses during operation.

To this end, the tablet press according to the invention is characterized in that said turret comprises a circumferential upstanding wall around said dies defining an enclosed space which forms part of the feeder system and which is adapted to contain a supply of the product, the scraper being arranged in said enclosed space and said punches and said cams being arranged to eject the produced tablets from the bottom of said dies.

In contrast to the currently used rotary gravity feed tablet presses, wherein the feeder system is an external system, the product for the tablets is fed in the tablet press according to the invention internally to the dies, more particularly within the enclosed space in the turret. This is achieved both by the centrifugal forces which urge the product contained in the enclosed space towards the peripheral portion thereof and by gravity. Since the steps of filling the dies with product, scraping off the excess of product and compressing the product are performed within the enclosed space, no product will be lost during these steps.

Moreover, just as in the currently used rotary gravity feed tablet presses, the centrifugal forces are relatively small compared to the known tablet presses using a feeder system based on centrifugal forces, so that no problems arise in the press according to the present invention with respect to density gradients in the tablets.

In an advantageous embodiment of the tablet press according to the present invention, said feeder system comprises a feeder tube disposed down-wardly above the bottom of said enclosed space, at the inner-side of said dies, and having its outlet situated at a distance from said bottom so as to form a gap allowing said product to flow out of said tube.

With such a feeder system, the maximum amount of product which will be present in the enclosed space will automatically be restricted due to the fact that the supply of product in the enclosed space will hamper the product from flowing out of the feeder tube. This effect will be maximized in the preferred embodiment of the

invention wherein the feeder tube ends centrally in the enclosed space.

Further particularities and advantages of the invention will become apparent from the following description of a particular embodiment of the rotary tablet press according to the present invention. This description is only given by way of example and is clearly not intended to limit the scope of the invention. The references used in this description relate to the annexed drawing wherein :

Figure 1 shows schematically a longitudinal sectional view of a rotary tablet press according to the invention, the frame of which has been omitted ;
Figure 2 shows, on a larger scale, a part of the tablet press of Figure 1 but this however in another position ;
Figure 3 shows a cross-sectional view according to line III-III in Figure 1.

The rotary tablet press according to the invention which is schematically shown in Figures 1 to 3 comprises a frame, only the connections 1 of which are shown, a motor 2, a drive shaft 3 mounted into bearings 4 and a turret 5 carrying the tools for making the tablets.

In the shown embodiment, the turret 5 consists of an upper 6 and a lower sub-turret 7 which are removably mounted onto each other, for example by means of screws which have not been shown in the figures. Of these sub-turrets 6 and 7, the lower sub-turret 7 is fixed by means of a screw 8 and a wedge 9 to the drive shaft 3.

The dies 10 for making the tablets are fixed by means of screws 11 into peripheral holes 12 in the upper sub-turret 6. The upper sub-turret 6 further comprises upper 13 and lower punches 14 which are slidably fixed thereto and which are arranged to cooperate with one another to compress product of which the tablets are to be made in the dies 10. This compression process is performed according to a cyclic movement upon rotation of the turret 5. To this end, the upper 13 and lower punches 14 cooperate respectively with an upper 15 and a lower cam 16, the shape of which is adapted in a known manner to the cyclic movement to be performed by the punches 13 and 14. In contrast to the rotating turret 5, the cams 15 and 16 are fixed with respect to the frame of the tablet press.

In the embodiment shown in the figures, the lower punches 14 cooperate with the lower cam 16 through the intermediary of punchholders 17 which are slidably mounted in the lower sub-turret 7. The lower punches 14 continuously engage these punch holders 17 due to the fact that they are resiliently urged thereto by means of springs 18. An important advantage of this embodiment is that it allows to replace a used upper sub-turret 6 quickly by another one when changing over to the production of other tablets or simply for cleaning the used turret.

In order to cooperate with the cams 15 and 16, the upper punches 13 and the lower punch holders 17 are provided with a mushroom head 19 but it will be clear that instead of mushroom heads 19 it is for example also possible to user rollers. In the embodiment shown in the figures, the cams 15 and 16 show grooves corresponding to the mushroom heads 19. At the location where high compressional forces are to be achieved for the final compression of the tablets, upper 20 and lower rollers 21 are further fixed with respect to the upper 15 and lower cams 16 and roll over the mushroom heads 19 to increase the pressure thereon. These rollers 20 and 21 can be seen on the right hand side of Figure 1.

In order to prevent product losses and contamination of the external sections of the press during the production of the tablets or when removing a used turret, the turret 5, more particularly the upper sub-turret 6, comprises a circumferential upstanding wall 22 around the dies 10, or in other words around the die table 23, thus defining an enclosed space 24 in the upper sub-turret 6. During the production of the tablets, this enclosed space 24 comprises a supply of product which is urged towards the circumferential wall 22, and thus towards the peripheral dies 10, due to the centrifugal forces generated by the rotation of the turret 5. In contrast to the known tablet presses, wherein the filling of the dies is entirely based on centrifugal forces, much smaller centrifugal forces are required in the tablet press according to the present invention since the actual filling of the dies 10 thereof is achieved by gravity, i.e. at the periphery of the enclosed space 24, the product simply falls into the dies 10.

In the tablet press according to the invention, the enclosed space 24 thus forms part of the feeder system for introducing the product of which the tablets are to be made into the dies 10. This feeder system preferably further comprises a feeder tube 25 disposed downwardly above the bottom of the enclosed space 24, i.e. above the die table 23, but this not above the dies 10 themselves as in the know gravity feed tablet presses, but at the innerside thereof. The feeder tube 25 is fixed with respect to the frame 1 of the tablet press to have its outlet situated at a distance from the die table 23. In this way, the product can flow out of the feeder tube 25 through the gap between its outlet and the die table 23. Due to this arrangement, the supply of product in the enclosed space 24 will be maintained automatically at the required level by continuous introduction of additional product from a container, in particular a funnel-shaped container 26, disposed on top of the feeder tube 25. Indeed, the outflow of product from the feeder tube 25 will automatically be limited by the amount of product which is already present in the enclosed space 24, especially in the preferred embodiment as shown in the figures wherein the feeder tube 25 ends centrally in the enclosed space 24, i.e. centrally with respect to the rotation axis of the turret 5. This central position of the feeder tube 25 allows further to close off the enclosed

space 24 also at the top, in particular by means of a cover 29 fixed within the circle formed by the upper punches 13 to the top of the upper sub-turret 6.

Before describing the working of the tablet press, it should further be noted that within the enclosed space 24, a scraper 27 is also provided for scraping off excess of product from the dies 10. This scraper 27 can for example be fixed to the feeder tube 25 and extends obliquely towards the upstanding wall 22 around the dies 10. The particular shape and position of the scraper 27 can be seen in Figure 3.

The compression cycle performed by the table press according to the present invention is defined by the shape of the upper and lower cams 15 and 16 and corresponds in principle to the compression cycle according to the known gravity feed tablet presses so that the compression cycle itself will not be described much into detail. However, an essential difference with the known tablet presses is that the tablets are not ejected from the top but instead from the bottom of the dies 10 as shown in Figure 2.

In broad outline, the working of the tablet press can be described as follows. In a first phase of the compression cycle, which takes place in front of the scraper 27, the dies are filled by gravity with product which is forced under the influence of the centrifugal forces towards the periphery of the enclosed space 24. At that phase, the upper punches 13 are in their highest position whilst the lower punches 14 are within the dies, defining a volume which may be somewhat greater than the volume of product required to make on tablet. In order to achieve the required volume, the lower punches 14 are subsequently moved upwards to the required level, after which the dies pass under the scraper 27. This scraper 27 does not only scrapes off the excess of product situated on top of the dies 10, but conveys this product towards the centre of the die table 23. In the product free space behind the scraper 27, the upper punches 13 are lowered into the dies 10, the complete compression being achieved at the location of the upper and lower rollers 20 and 21 shown in Figure 1. For ejecting the compressed tablets, both the upper and lower punches move downwards to eject the tablets from the bottom of the dies, more particularly in the tablet chute 30 which can be seen in figure 2. In the next phase, the upper punches 13 are removed from the dies 10 whilst the lower punches 14 enter the dies 10 from beneath so that the die cavities can be filled again with product.

The main advantage of the tablet press according to the present invention is first of all that product losses during the production can be eliminated due to the fact that the filling of the die cavities and the compression process are performed within an enclosed space. This reduces also considerably the risks that an operator may come into contact with noxious products either during the production or when removing the upper sub-turret. A further advantage of the above described embodiment is that the funnel-shaped container 26, the feeder tube 25 and the upper sub-turret 6, comprising the upper and lower punches 13, 14 and the dies 10 can quickly be replaced so that a minimum of production time is lost when changing over to another product and/or when these parts have to be cleaned.

Another important advantage of the new turret structure according to the present invention is that it is very suited for being cleaned in place. The upper sub-turret 6 can first of all be cleaned by means of a vacuum cleaner either through the feeder tube 25 or by removing the cover 29. Subsequently, hot or cold cleaning liquids can be introduced into the upper sub-turret 6 through the same ways, either with or without pressure, and can be extracted therefrom after the corresponding cleaning cycle is completed. This cleaning process can be repeated as many times as required. Finally, the sub-turret is dried with cold or hot air blown for example through the feeder tube 25. The cleaning liquids which escape through the necessary play between punches and dies 10 will be drained by a therefore provided collector 31. The section of the lower punches outside the sub-turret is cleaned with spray nozzles 32 while cleaning liquid is also drained by the collector 31, this process is repeated as many times as necessary. Also the outside of the tablet press can be dried subsequently with air.

It is clear that due to the possibility of providing an efficient clean in place (C.I.P.) system, it is not absolutely necessary to divide the turret 5 into two sub-turrets 6, 7 so that it is also not necessary to use punch holders for the lower punches.

From the above description, it will be clear that the invention is not limited at all to the described particular embodiment but that, on the contrary, all kinds of modifications can be applied thereto without leaving the scope of the present patent application.

It is for example possible to provide more than one compression cycle per revolution of the turret and it is even possible to adapt the turret to the production of multi-layer tablets.

Claims

1. A rotary tablet press comprising a rotating turret (5) provided with peripheral dies (10), a feeder system for introducing product for the tablets into the dies (10), a scraper (27) for scraping off excess of product introduced in the dies (10), a series of lower (14) and upper punches (13) which are slidably fixed to said turret (5) and arranged to compress the product introduced in said dies (10) according to a cyclic movement into tablets and a lower (16) and upper cam (15) cooperating respectively with said lower (14) and upper punches (13) to move these punches according to said cyclic movement upon rotation of the turret (5), characterized in that said turret (5) comprises a circumferential upstanding wall (22) around said dies (10) defining an enclosed

space (24) which forms part of the feeder system and which is adapted to contain a supply of the product, the scraper (27) being arranged in said enclosed space (24) and said punches (13, 14) and said cams (15, 16) being arranged to eject the produced tablets from the bottom of said dies (10).

2. A tablet press according to claim 1, characterized in that said feeder system comprises a feeder tube (25) disposed downwardly above the bottom (23) of said enclosed space (24), at the innerside of said dies (10), and having its outlet situated at a distance from said bottom (23) so as to form a gap allowing said product to flow out of said tube (25).

3. A tablet press according to claim 2, characterized in that said feeder tube (25) ends centrally in said enclosed space (24).

4. A tablet press according to any one of the claims 1 to 3, characterized in that said turret (5) comprises an upper (6) and a lower sub-turret (7) which are removably mounted onto each other, the upper sub-turret comprises the enclosed space (24), the dies (10), the upper punches (13) and the lower punches (14) whilst the lower sub-turret (7) comprises lower punch holders (17) slidably mounted therein and arranged to cooperate with the lower punches (14) and the lower cam (16) to subject to lower punches (14) to said cyclic movement.

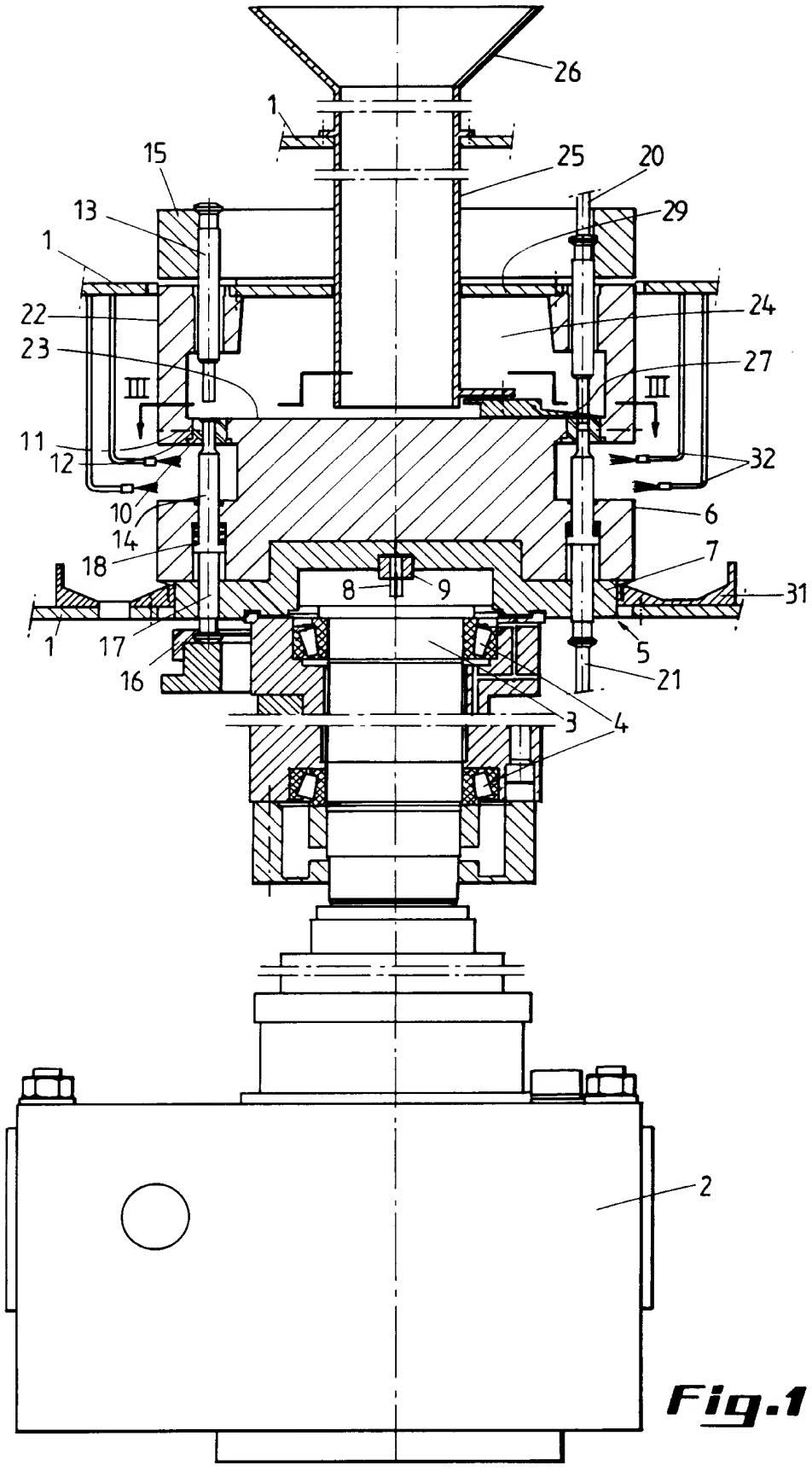
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Fig.1

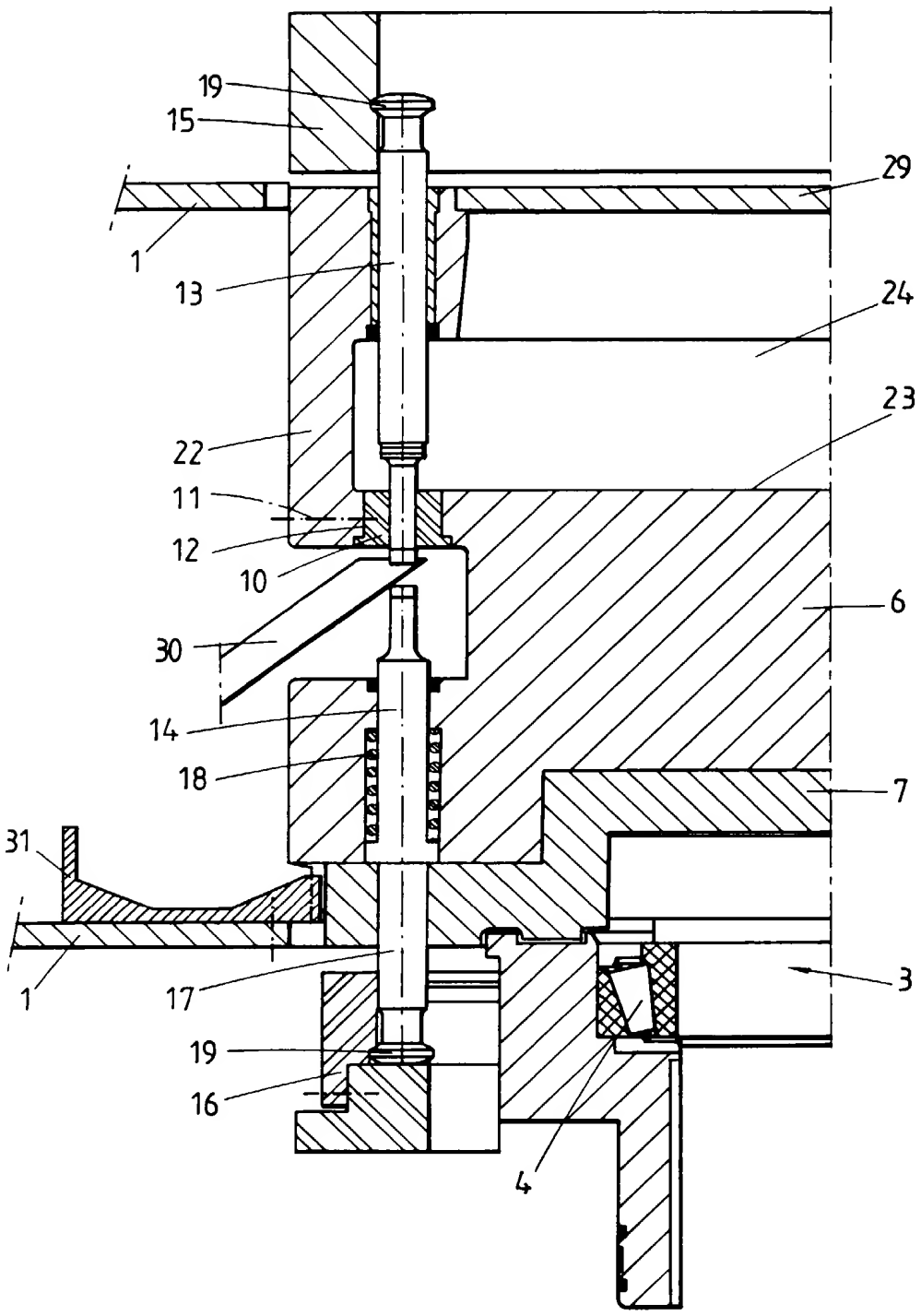

Fig.2

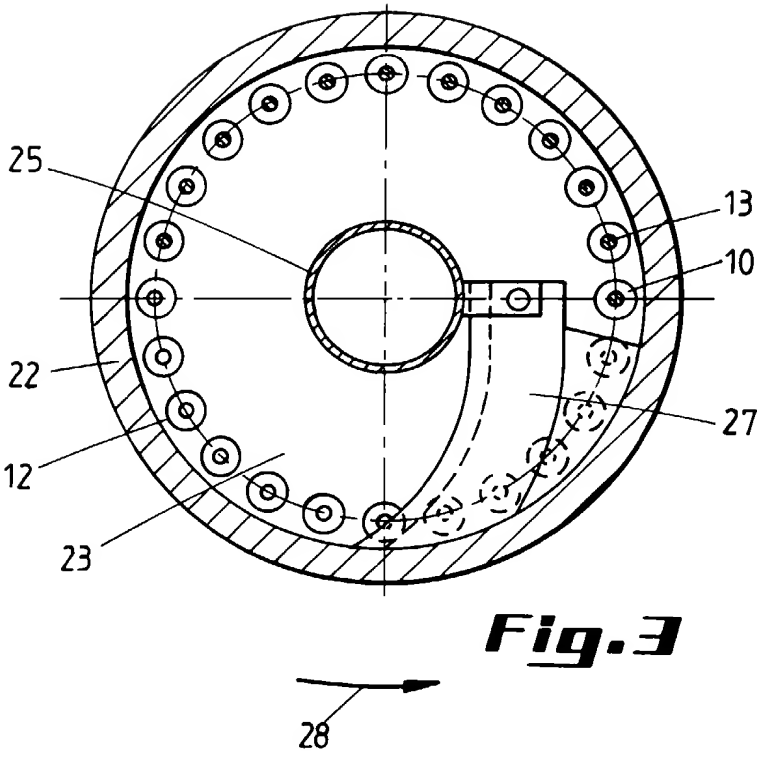

Fig.3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 87 0104

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
E	EP-A-0 743 169 (BWI PLC) 20 November 1996 * the whole document * ---	1-3	B30B11/08 B30B15/30
X	DATABASE WPI Section Ch, Week 8126 Derwent Publications Ltd., London, GB; Class J04, AN 81-47436D XP002021908 & SU-A-770 836 (SEMENOV V M) , 16 October 1980 * abstract; figures * ---	1-3	
A	FR-A-2 625 461 (IMA SPA) 7 July 1989 * the whole document * ---	1	
A	US-A-3 566 806 (FORSTER ERIC ET AL) 2 March 1971 * the whole document * ---	1,2	
A	WO-A-95 15846 (IMA SPA ;ROVATTI FABBRI PAOLA & HF (IT)) 15 June 1995 * page 10, line 14 - line 24 * ---	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B30B
A	GB-A-1 070 587 ("VNIIELECTROMASH") * the whole document * ---	1	
A	DATABASE WPI Section PQ, Week 9215 Derwent Publications Ltd., London, GB; Class P71, AN 92-121942 XP002021898 & SU-A-1 648 791 (MARIUPOL LENGD PROG) , 15 May 1991 * abstract; figures * -----	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 January 1997	Voutsadopoulos, K

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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